User Guide for Running a Project on the Embest Board

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1. Overview

The Embest University® board is a development board for embedded systems which is used with the Embest IDE (Integrated Development Environment). The board is based on the ARM 7TDMI core processor. It is particularly suitable for use in university courses at both the undergraduate and graduate levels in computer science, computer engineering and electrical engineering. The IDE supports embedded software development on the Embest board. Through its graphical user interface, it facilitates managing and building projects, as well as allowing applications to be run and debugged.

This guide only explains how to integrate an ARM assembly file into a previously prepared Embest IDE project. A separate document named "*Guide for Building a New Project on the Embest Board*" describes how to prepare a new project using the Embest IDE. Appendix 1 contains a description of the Embest University® development board. A set of companions Power Point slides is also available to be used in a lab environment.

This document assumes a basic knowledge of ARM assembly language and the ARM architecture.

2. Embedding ARM Assembly Code into an Embest Project

Integrating an ARM assembly language source file into a previously prepared project for the Embest IDE can be accomplished in these four stages (as shown schematically in Figure 1):

1. Open the previously prepared project using the Embest IDE.
2. Add the assembly source file to the project.
3. Build the project.
4. Execute the project on the Embest University® board.

The following sections present detailed explanations of each step. This documentation is intended to walk a new user through the steps above, using as an example an assembly source file, called "`InsertARM1.s`," into a previously prepared Embest IDE project, called "**ProjectGuide1**". [1]

2.1 Opening a Previously Prepared Project

To start the Embest IDE application, select the folder reached by **Start Menu → Programs → EmbestIDE Pro Education Edition for ARM**; and from inside this folder select **→ EmbestIDE Pro Education Edition for ARM**. The Embest IDE should start, appearing as shown in Figure 2.

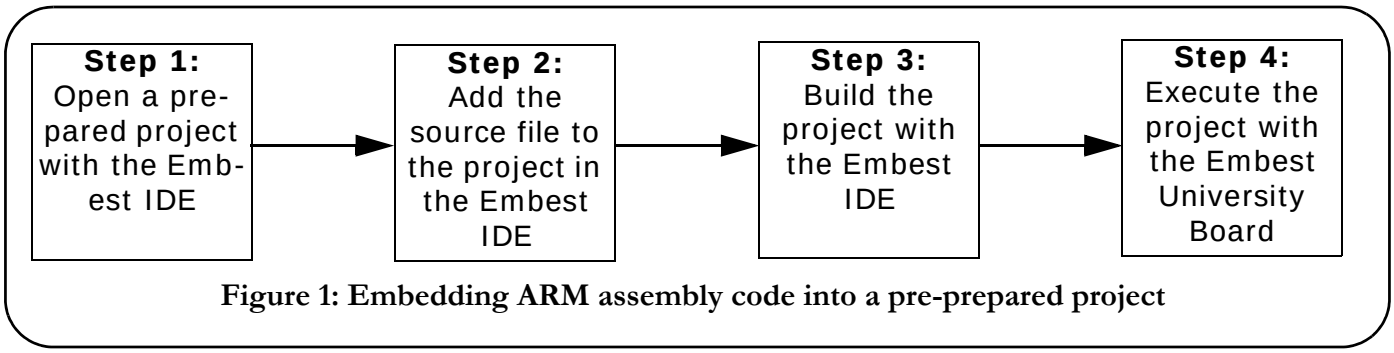

Figure 1: Embedding ARM assembly code into a pre-prepared project

1. The local user can download "ProjectGuide1" from the Resources section of the web pages. Important note: The project folder should be downloaded onto the user's locally allocated space, i.e. the H: drive.

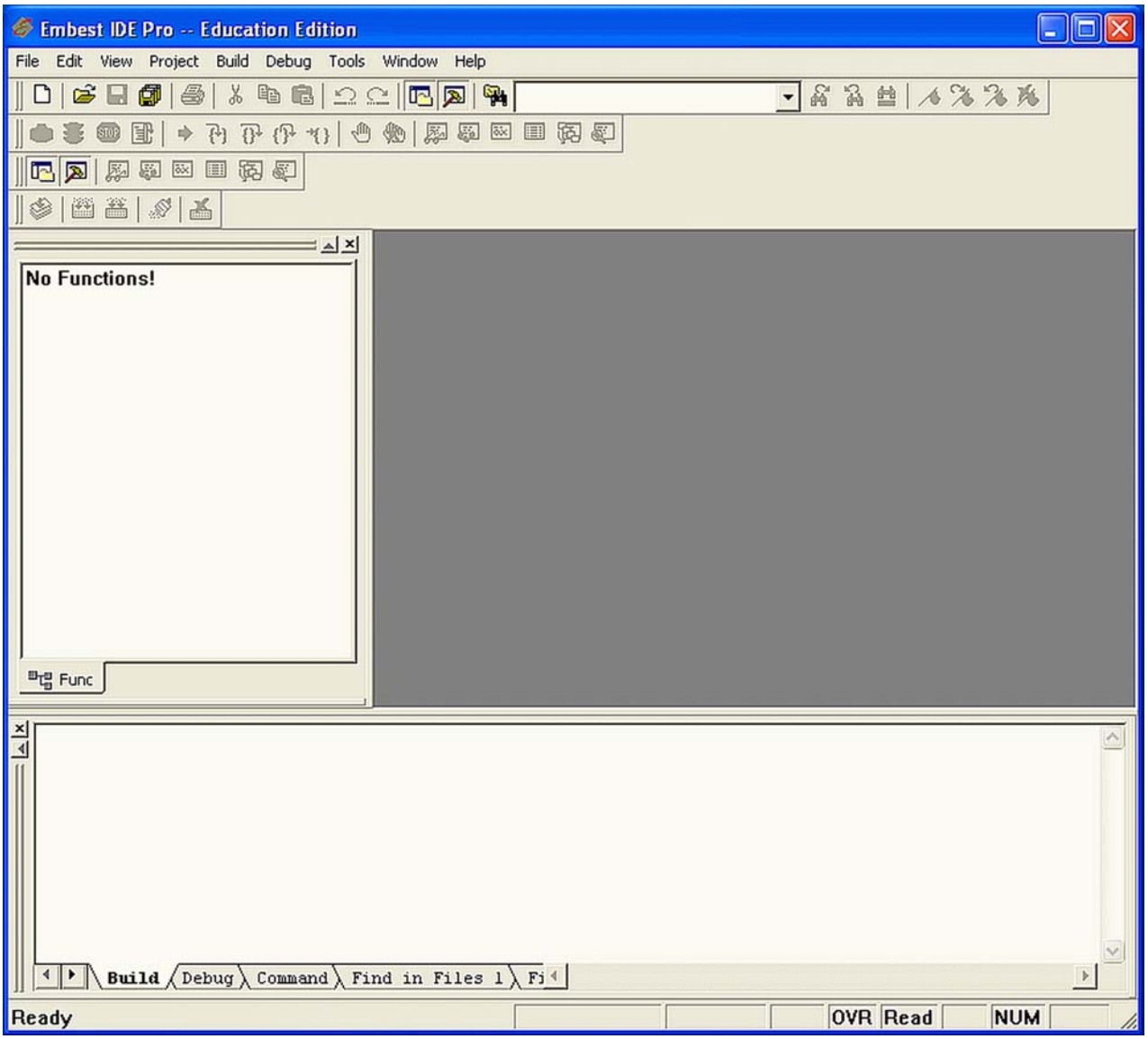

Figure 2: Startup window of the Embest IDE

To open the sample project for this guide, namely **ProjectGuide1**, first select **File → Open Workspace**. A pop up window appears. Locate the **ProjectGuide1** folder by navigating to its location, and then select the file called **ProjectGuide1.ews**. The *.ews* extension stands for Embest Workspace. Upon completion, the Embest IDE should resemble Figure 3. It is assumed here that the sample project has been saved on a user drive.

The Embest IDE has several components, each with different functionality. The top Menu follows the usual pattern containing several submenus such as File, Edit, and Build. At the top right there is a Toolbar for the most commonly used tools.

The top-left window is the *Workspace Window* displaying information regarding files in the current open project. The top-right window is the *Source Code Window* where the user views and edits code. The bottom *Output Window* displays the status of the project being built, file search output information, command-line input and output information, depending on the current use. At the very bottom, the *Status* border displays detailed information for the current use of the menu and tool bars, as well as the cursor's current line and column number in the *Source Code Window* when in use. In Figure 3, it simply shows the "Ready" status. Various tabs are also available depending on the current use (see below).

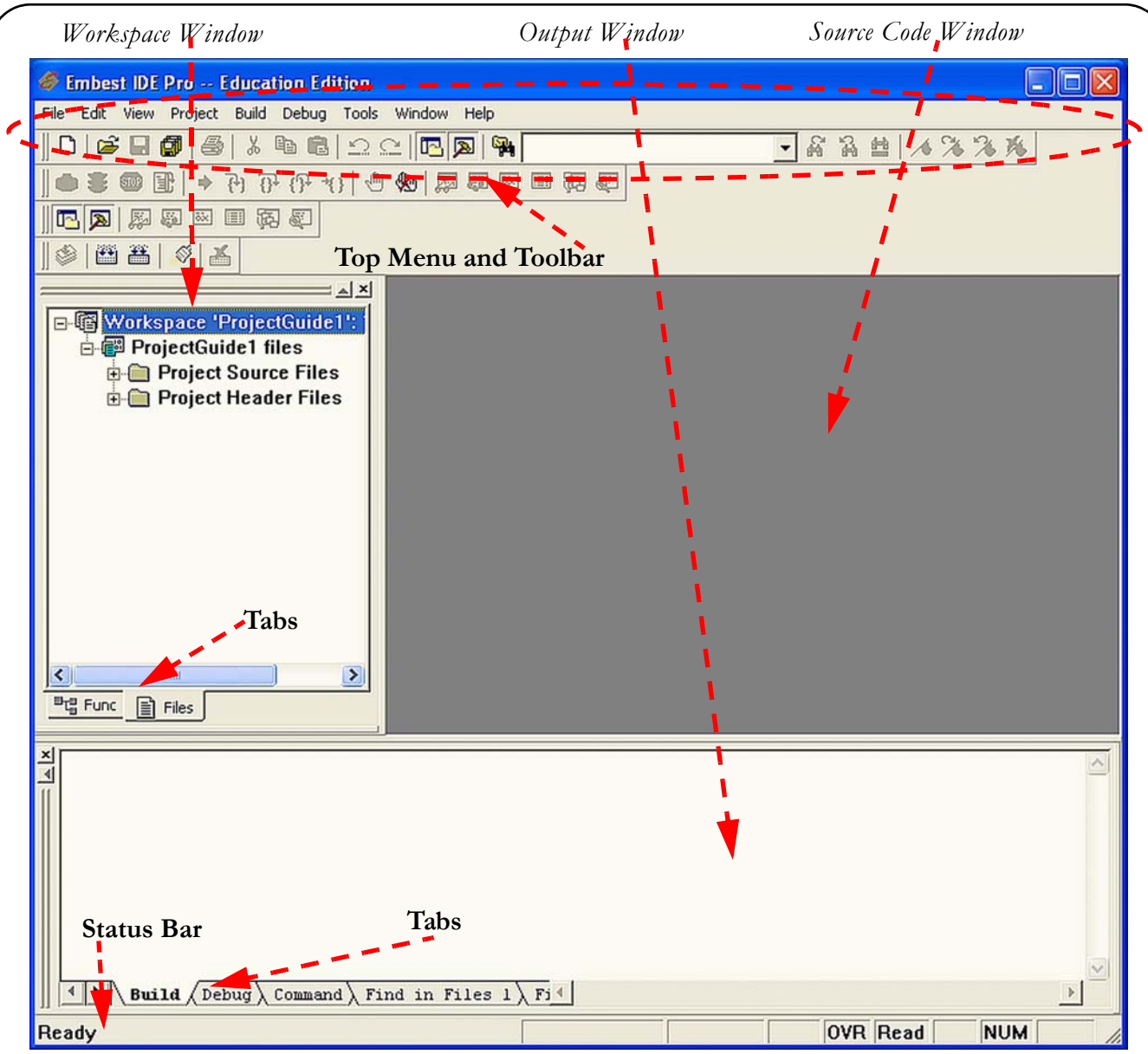

Figure 3: After opening the project ProjectGuide1.

Exploring further the sample **ProjectGuide1**, select the "Files" tab available at the bottom border of the *Workspace* Window. There are two sub-folders in the **ProjectGuide1** workspace: **Project Source Files** and **Project Header Files.** These folders each contain a collection of files which are used by the project builder software to connect to various components of the Embest board.

For example, the `lcd.s` source file in the **Project Source Files** folder and the `lcd.a` archive file in the **Project Header Files** folder are associated with the LCD screen functionality on the Embest board. In this prepared project, all these files have been constructed in advance and can thus be ignored for the moment. Further explanation on how to implement these files will be available in Part 2 of this document.

2.2 Adding an Assembly Source File to the Project

The second stage is to integrate the assembly language source file, `InsertARM1.s`, into the **ProjectGuide1** project. This can be accomplished in two steps:

1. In the *Workspace* window, right click the folder **Project Source Files** and select **Add Files to Folder.**

2. Locate and select the `InsertARM1.s` file. The file will appear in the list of files belonging to the **Project Source Files** folder in the *Workspace* window**.**

Note: adding a file to a project creates a reference from the project to the file. It does not create a new copy of the file for the project. Therefore one needs to be careful if the same file is added to two different projects.

After adding`InsertARM1.s` to the **ProjectGuide1** workspace, its code can be viewed in the *Source* code window by double clicking the `InsertARM1.s` file in the *Workspace* window. The result is shown in Figure 4.

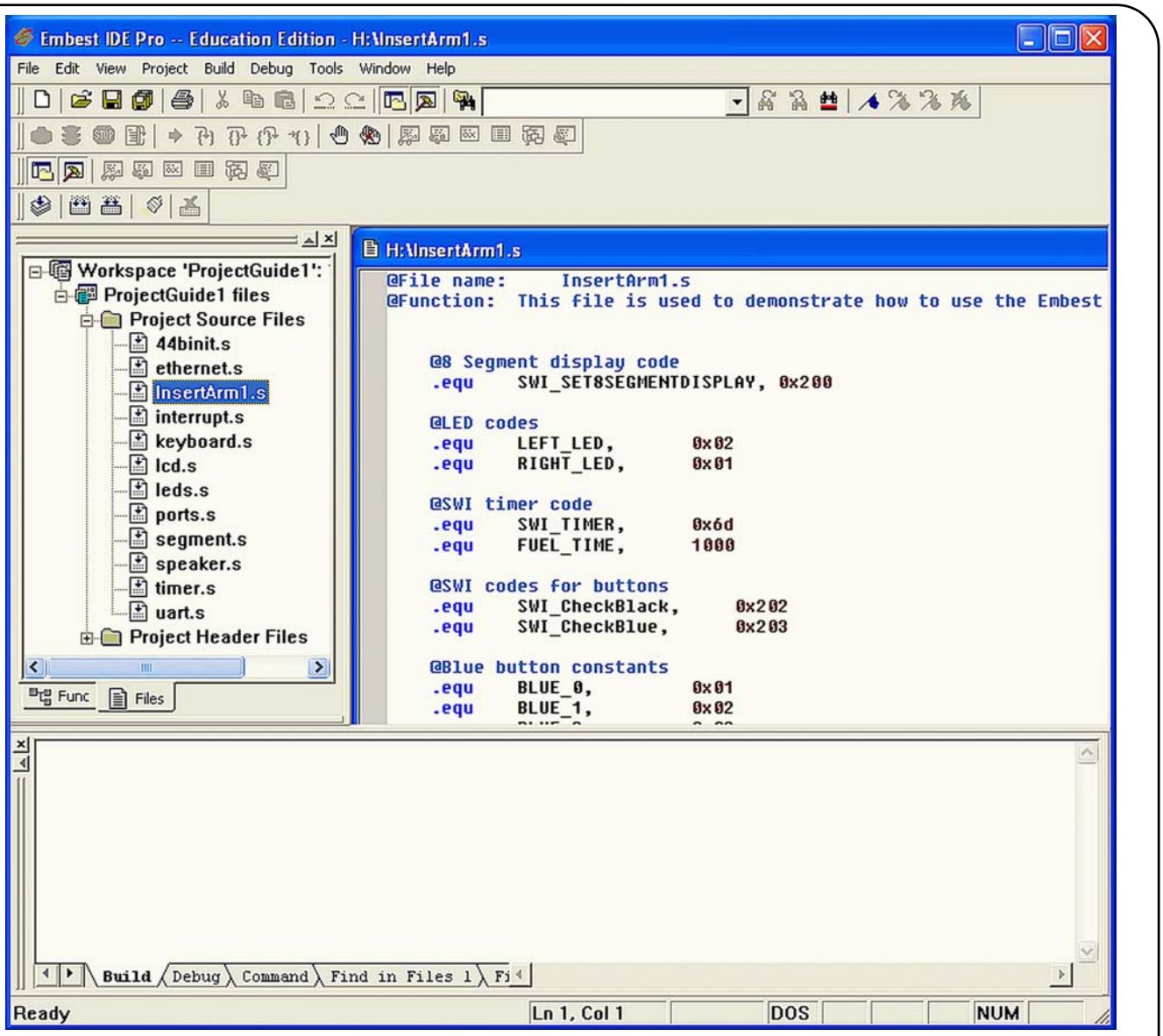

Figure 4: After adding the source file InsertArm1.s

2.3 Building the Project

Once the file `InsertARM1.s` has been added to the project as above, the workspace is ready to be built. In this context, "building" a project implies assembling and linking all the files within it, ready to be downloaded and executed.

To build a workspace, go to the **Build** dropdown menu item (top border of the overall window) and select **Rebuild All.** Provided that no errors occur when building the project, the output message *"Command(s) successfully executed*" appears in the *Output* window with the tab "Build" (refer to the bottom of Figure 2). In addition

this stage also produces a file called **ProjectGuide1.elf** (the *.elf* extension indicates the *executable linking file* format*)*. **ProjectGuide1.elf** is the file to be downloaded into the memory space of the Embest board. It is created inside the project's folder, as listed in the *Workspace* window.

2.4 Executing the Project on the Board

The final stage is to download and execute the project on the Embest board. For clarity, this stage is divided into four steps as:

1. Prepare the project for download.
2. Connect to the Embest University® board.
3. Download the executable to the board.
4. Run the project.

2.4.1 Preparing the Project for the Download

At the top of the Embest IDE overall window, click on the **Project** dropdown menu and select the **settings** option. The *Project Settings* window will appear, as shown in Figure 5. Select the tab labelled **Debug.**

A text field labeled *Symbol File* will appear. Click the button beside this text field (see Figure 5) and locate and select the **ProjectGuide1.elf** file.

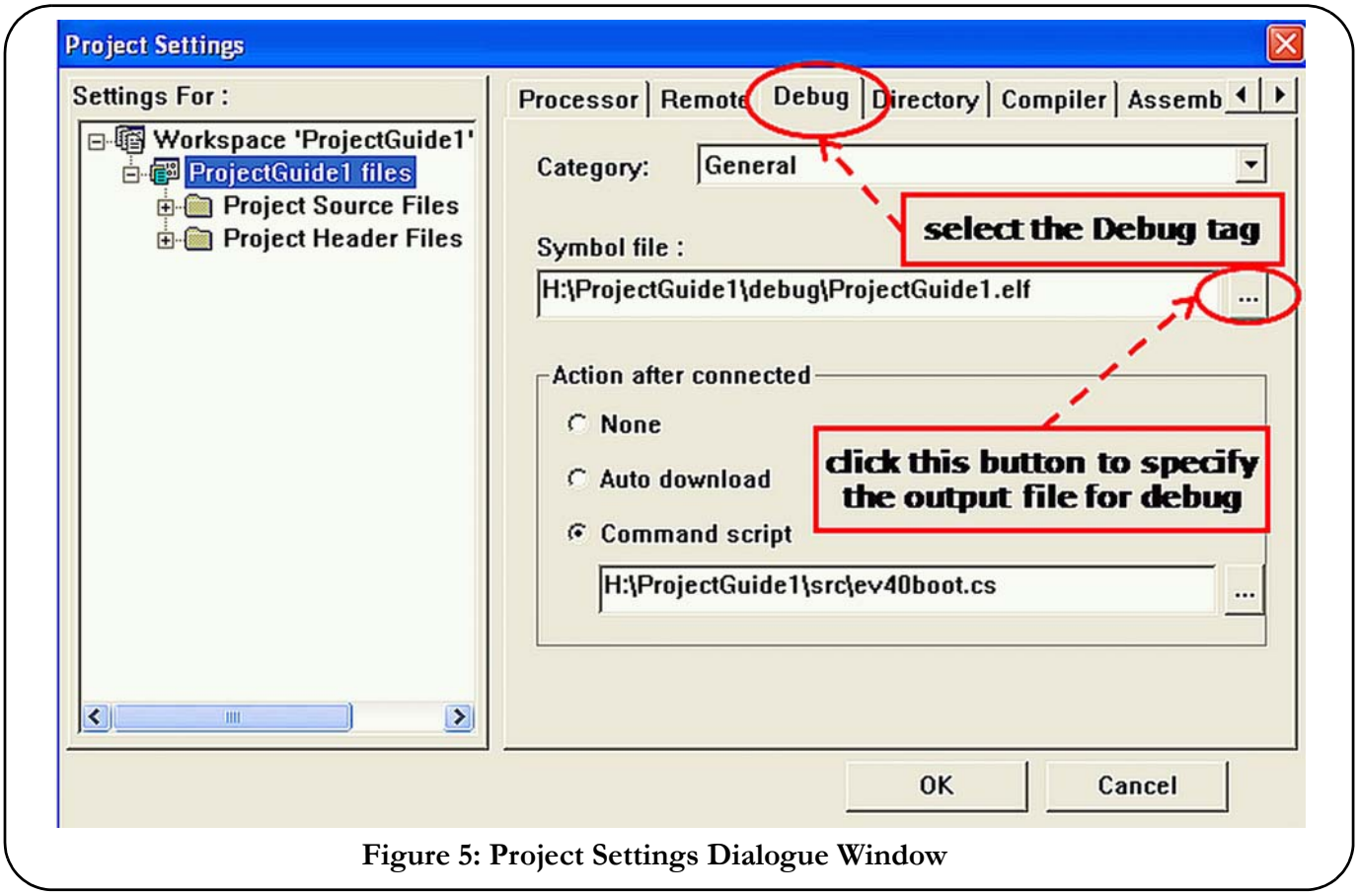

Figure 5: Project Settings Dialogue Window

Next, select **Download** in the **Category** dropdown menu, as shown in Figure 6. To confirm the new settings, click the **OK** button at the bottom of this dialogue window.

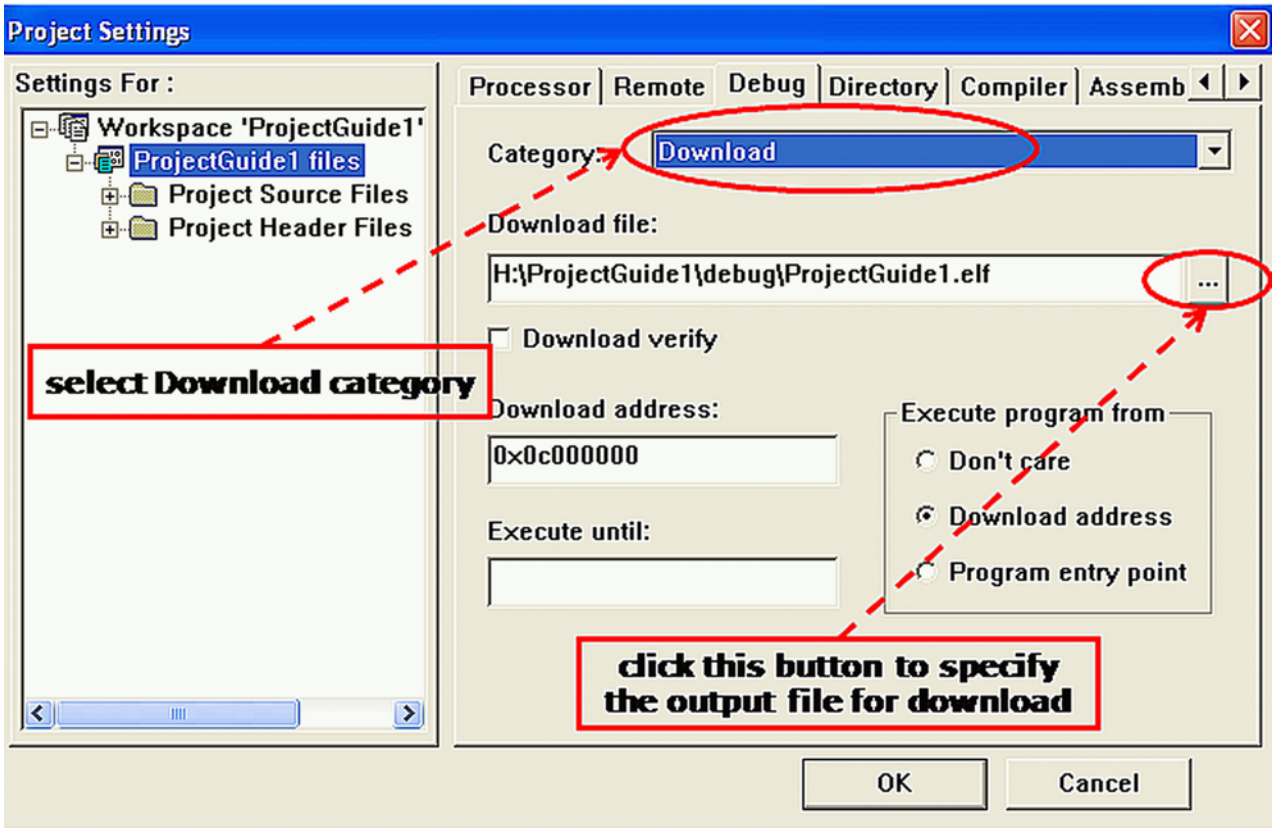

Figure 6: Project Setting for Download

2.4.2 Connecting to the Embest University® Board

Prior to turning on power to the Embest University® board, ensure that all connections, including the serial port line between the board and PC host, as well as the board's external power supply, are properly attached. Consult the illustrations in Appendix 1.

Use the power switch, labeled **SW3** in Appendix 1, to turn the power on. The next step is to establish communication between the Embest IDE and the board. Choose the **Debug** dropdown menu in the main window and select the **Remote Connect** option.

If the connection is successfully established, the *Output* window will display the message "*memwrite success*" and the Embest IDE will switch its status to *Disassembly*, as shown in Figure 7. If however, the board and Embest IDE fail to establish a connection, an error message will appear in the *Output* window under the tab **Debug**.

2.4.3 Downloading the Executable to the Embest University® Board

Now that the board and the Embest application are successfully connected, the executable file can be copied onto the board's memory space. To download **ProjectGuide1.elf**, go to the **Debug** menu tab and select the **Download** option. A loading bar appears at the bottom of the Embest IDE while the elf file is being downloaded. This is illustrated in Figure 8 below. When the download is complete, the *Status* border will display the message "*Info: download completed*".

2.4.4 Running the Project

Running the project means using the Embest University® board to execute the code and interact with the board component as the application requires. Once the project has been successfully downloaded, go to the **Debug** menu and select the **Go** option. The executable should begin running on the board.

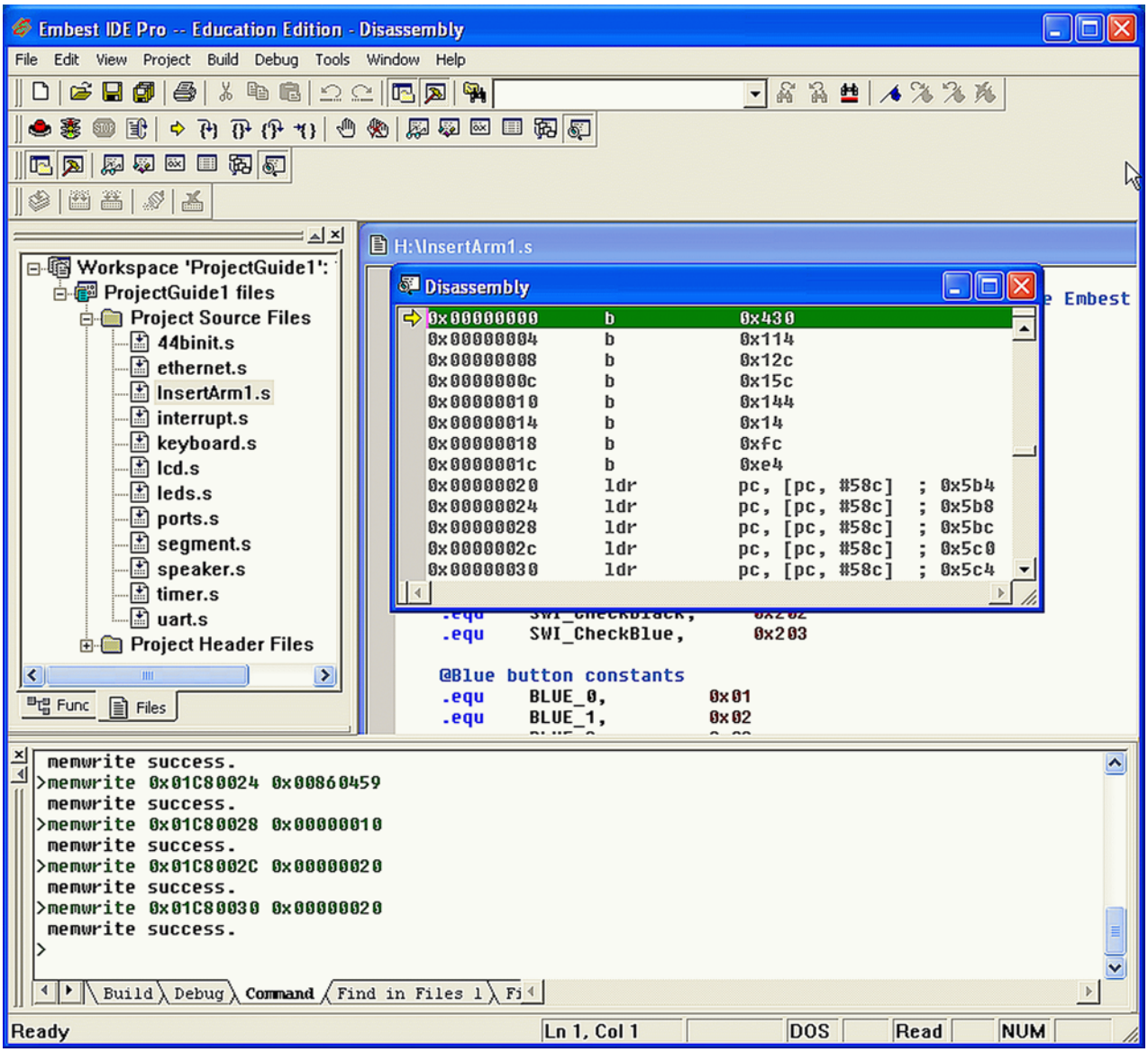

Figure 7: The Disassembly View

2.4.5 Stopping and Disconnecting the Project

In order to terminate the board host connection, go to the **Debug** menu and select the **Disconnect** option. Then turn off the power switch.

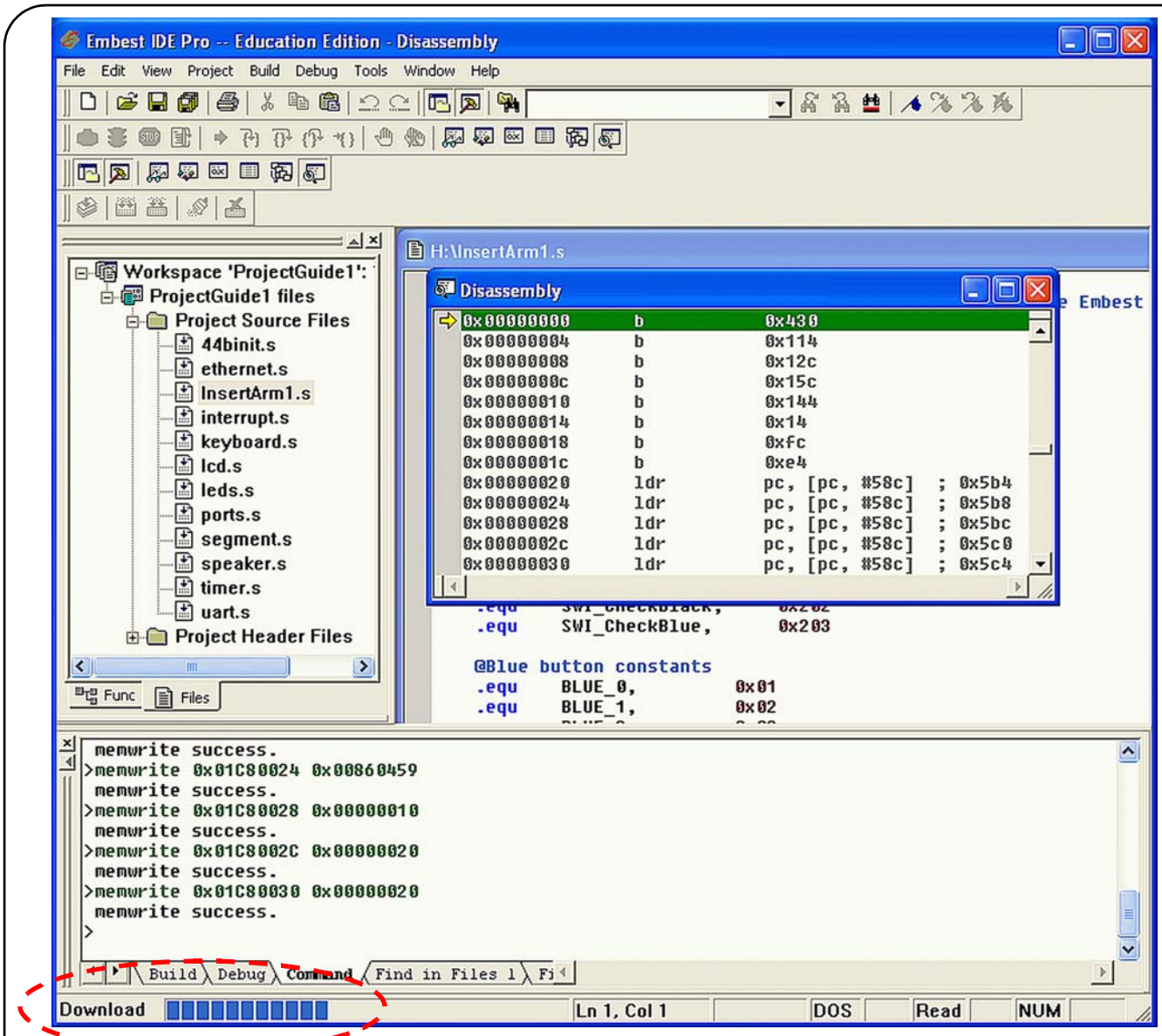

Figure 8: Downloading

Appendix 1: Description of the Embest University® board

The Embest University® board consists of two parts: the Main Board, and the board with the LCD and Keyboard as shown in Figure 9.

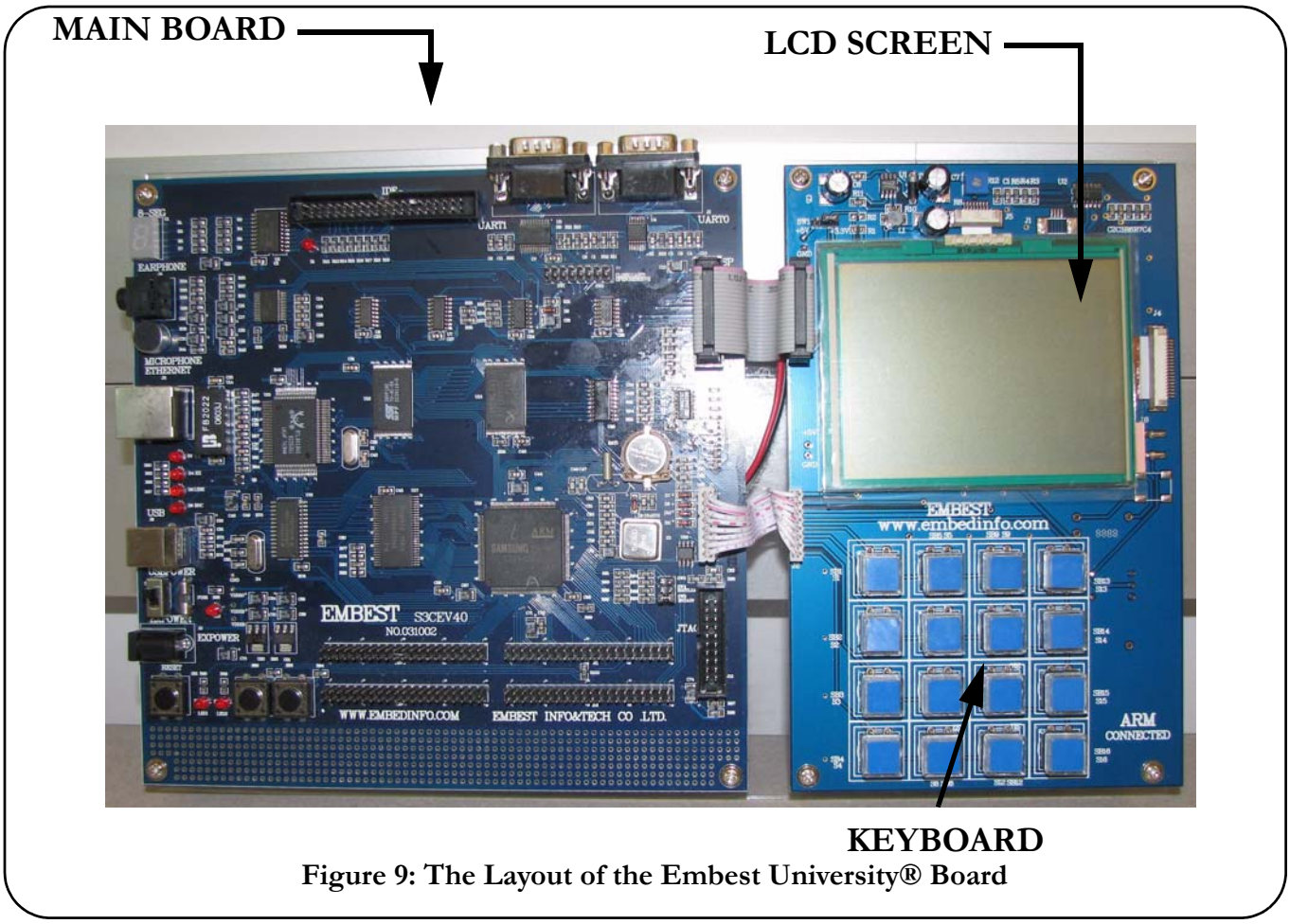

Figure 9: The Layout of the Embest University® Board

The Main Board includes several peripheral components, listed in Table 1. .

Table 1: Some of the Peripheral Components of Embest University® Board

Label	Component
8-SE	8-Segment Display
IDE	External IDE port
EarPhone	Earphone Output
MicroPhone	Microphone Input
Ethernet	10M Ethernet Interface Connector
USB	USB Connector
LCD	320*240 mono LCD Screen Display
POWER	External Power Button
RESET	Reset Button
UART	Universal Asynchronous Receiver/Transmitter

The structure of the Main Board is shown in Figure 10.

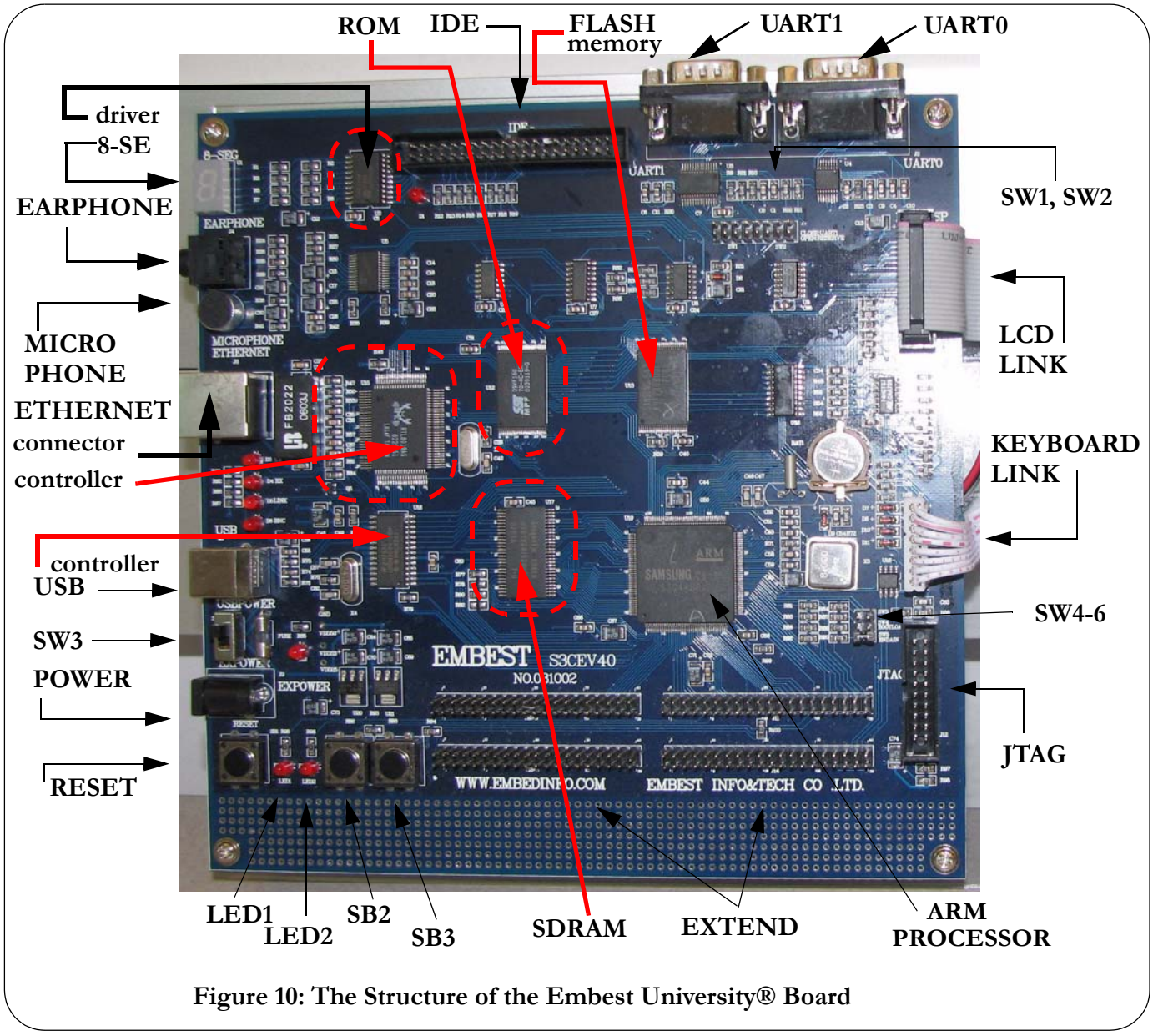

Figure 10: The Structure of the Embest University® Board